POISONED AIR

by

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POISONED AIR

POLLUTION of the atmosphere in urban areas of the United States, once no more than a tolerable annoyance, in the short space of 15 years has become a disturbing threat with overtones of deadly menace. Smoke that used to darken and smirch cities like Pittsburgh has given place to the smog that periodically chokes Los Angeles and other American communities. Meanwhile, people of country and city alike, east and west, face a dread evil of uncertain proportions in the new phenomenon of radioactive fall-out.

Up to World War II, control of air pollution was mostly a question of smoke abatement. Since then the vast growth of industrial production, and in particular the expansion of the chemical industries, have made air contamination much more difficult to deal with and potentially, if not always actually, much more damaging to the health and property of the inhabitants of industrial communities. Now there is the new and general threat that the air may be poisoned by radioactivity, heavily if nuclear weapons are used in war, less heavily but possibly with disastrous long-range effects if nuclear test explosions become too numerous.

Prospective Increase in Federal Research Funds

Both the intensification and the newness of the problem of air contamination are evidenced by the fact that it was not until last year that the U. S. Public Health Service had funds for and initiated a specific air pollution program. The extent of the menace of radioactive fall-out is still in the realm of controversy. The lower house of Congress showed that it took a grave view of dangers from that source in case of war when it amended the Independent Offices Appropriation bill from the floor, Mar. 30, to authorize the Federal Civil Defense Administration to use a $30 million fund to buy fall-out detection devices for distribution among local civil defense agencies.

President Eisenhower touched on the general problem of air contamination in a special message, sent to the Capitol on Jan. 31, on health programs and recommendations. Urging Congress to "step up research on air pollution," the President pointed out that "As a result of industrial growth and urban development, the atmosphere over some population centers may be approaching the limit of its ability to absorb air pollutants with safety to health." Eisenhower added that he was "recommending an increased appropriation to the Public Health Service for studies seeking necessary scientific data and more effective methods of control."

During the fiscal year that began last July 1, the sum of $182,000 was made available to the Public Health Service to carry on research in control of air pollution at the government's new Robert A. Taft Sanitary Engineering Center at Cincinnati.[1] For the fiscal year that begins next July 1, the Public Health Service asked that that amount be increased by $412,500 to a total of $594,500. It proposed also that, as in the previous year, the sum of $125,000 be allotted from general research funds for grants to nonfederal public and private agencies for research in air contamination. An additional item of $23,000 was asked to finance a joint U. S.-Canadian study of air pollution in the Detroit-Windsor area. The grand total sought for air pollution activities in the fiscal year 1956 thus was $742,500. The House Appropriations Committee approved the major requests, and they were granted in the appropriation bill as it passed the House on Mar. 21.[2]

Assistant Surgeon General Hollis of the Public Health Service, justifying the appropriation requests, told a House Appropriations subcommittee on Feb. 11:

> Today over wide areas we have reached the stage where the capacity of the community environment to absorb wastes is taxed to the limit. Bad enough in itself, this situation is just the beginning. . . . In more and more areas the buildup of air pollution is now approaching the critical stage. The situations in such cities as Los Angeles, Cleveland, Louisville, and on Staten Island, are but examples of a generalized condition rapidly developing over most

[1] Limited expenditures on special air polution projects had previously been made from time to time out of funds appropriated for sanitary engineering activities in general.

[2] The report of the House Appropriations Committee on the Departments of Labor, and Health, Education and Welfare, and Related Agencies Appropriation bill gave $743,500 as the total increase allowed for "research in connection with air pollution control and water pollution control and the basic laboratory facilities and activities related thereto." No major item for air pollution control was disallowed. The item of $23,000 for the Detroit-Windsor study is to be included in the State Department appropriation bill for transfer to the Public Health Service.

> metropolitan areas. Public reaction to this development is one of great apprehension and demand for prompt corrective measures.

Hollis added that much more research was needed to find fundamental answers to questions about the effects of air pollution that were coming from an alarmed public. "We do know how to remove certain types of matter, and working with industry we can get certain corrective measures installed in industry. However, fundamental knowledge of the overall problem and how to move ahead with the corrective measures is not known."

Additional funds were asked for the air pollution control program of the Taft Center chiefly to (1) initiate studies of the health effects of air pollutants; (2) extend to some 30 cities the Center's current program of gathering and analyzing samples of polluted air; (3) study the relationship between community air pollution and weather phenomena; (4) evaluate air cleansing procedures; (5) extend technical aid to state and local agencies and assist them in training technical personnel. Hollis said the program to be developed with the additional money would help to establish "some medical intelligence in the field [of air pollution]."

Bills in Congress to Foster Anti-Pollution Action

More than a dozen bills dealing with problems of atmospheric contamination have been introduced in Congress at the current session. In general, the bills propose either (1) to extend federal activities concerning air pollution, particularly in support of research and technical aid to states and localities, or (2) to provide economic incentives to private interests for the installation of pollution-abatement facilities.

A measure introduced by Sen. Kuchel (R-Cal.) and cosponsored by Sens. Knowland (R-Cal.), Martin (R-Pa.), and Duff (R-Pa.) would amend the Water Pollution Control Act of 1948 to institute a program of similar scope in the field of air pollution.[3] The bill would authorize the Surgeon General of the Public Health Service to prepare a "comprehensive program for eliminating or reducing air pollution"; conduct experiments and investigations; collect and disseminate information on prevention and abatement;

[3] The Water Pollution Control Act is due to expire by limitation on June 30, 1956. Several bills now pending in Congress would give the act permanent status and expand federal activities in the fields of both water and air pollution.

encourage enactment of uniform state laws on air pollution; and furnish technical assistance to states or localities. In addition, it would create an Air Pollution Control Advisory Board of six private citizens appointed by the President and six government officials appointed by their agency chiefs.[4]

Most of the activities mentioned in the Kuchel bill are already within the scope of the general authority of the Public Health Service to deal with environmental health problems. Enactment of the bill, however, would strengthen the air pollution phase of the public health program by giving it a specific mandate from Congress and establishing an advisory group exclusively devoted to the problem. When the California senator introduced the bill on Feb. 4, he said:

> Because this menace is increasing in seriousness and a potential threat exists in numerous places where so far the danger has not become apparent, I have become convinced that a broad attack must be made on smog without delay. I have consulted with eminent scientists, civic leaders, and public officials in all levels of government. They invariably concur in my feeling that federal participation is essential if any campaign to clean up the atmosphere is to succeed.

A bill introduced in the House on Feb. 7 by Rep. McDonough (R-Cal.) would authorize an appropriation of up to $5 million to enable the Department of Health, Education and Welfare to expand technical research on the causes, hazards, and effects of air pollution; develop devices and methods for pollution abatement; and give more technical assistance to state, interstate, and local agencies. McDonough said potential danger from atomic fall-out "clearly indicates the urgent need of an immediate study of this hazard." Even if radioactive contamination were disregarded, he added, pollution from other sources urgently demanded attention.

Incentives to Combat Contamination of the Air

In many instances the technical obstacles to abatement of air pollution are not as formidable as the high cost of the facilities required to do the job. Louis C. McCabe, chief of the fuels and explosives division of the U. S. Bureau of

[4] The presidential appointees would include at least one engineer and one representative each of a state government, a local government, and an affected industry. The other appointees would be named by the Surgeon General, the director of the National Science Foundation, and the Secretaries of Agriculture, Commerce, Defense, and Interior.

Mines, told a congressional committee last spring that he thought the economic problem was "the greatest factor that has hindered development of facilities to prevent air pollution."

Under a bill introduced by Sen. Martin (R-Pa.), with six other senators from industrial states as co-sponsors, purchasers of treatment facilities to abate air or water pollution would be permitted to amortize the costs over a five-year period for tax purposes. A number of like measures have been offered in the House of Representatives. In addition, a bill by Rep. Hiestand (R-Cal.) would authorize the Housing and Home Finance Administrator to guarantee or extend low-interest loans for the purchase or construction of facilities to reduce the amount of air contamination in a community.

The Senate Banking and Currency Committee last year endorsed a proposed amendment to the Housing Act which would have authorized such loans and loan guarantees and also directed the Department of Health, Education and Welfare to assist local communities in the study and solution of air pollution problems. Sen. Capehart (R-Ind.), who was chairman of the Banking Committee in the 83rd Congress, was joined by the two California senators on Mar. 28 in sponsoring a bill embodying the substance of the Housing Act amendment put forward in 1954. The Banking Committee's report on the proposal at that time asserted that it did not make sense for the federal government to spend large sums to help eliminate slums, unless at the same it did something about "one of the important contributory causes of our slums and blighted areas—smoke and air pollution."

Nature and Effects of Air Contamination

ONLY A FEW YEARS AGO air pollution was limited mostly to the fouling of the atmosphere that occurred on still days when clouds of black smoke billowed from the chimneys of factories, office buildings, and apartment houses. It was more a matter of discomfort than of danger to health. However, many communities grew impatient when palls of smoke increasingly obscured the sun and

more and more soot sifted down on houses, house furnishings, and clothing. They reacted by requiring industrial plants to locate some distance from residential centers or by directing soft coal users to take certain measures—such as raising the height of smokestacks—to abate the nuisance.

There were few technical difficulties in simple smoke abatement. But the nature and volume of air pollution have changed radically in recent years. Since the beginning of World War II, the volume of industrial production has more than doubled and new types of noxious materials, sometimes hard to identify and often unaccompanied by visible fumes, are escaping into the atmosphere. The population, moreover, has become more concentrated in metropolitan areas that include large agglomerations of industry. Effluvia released in the burning of fuel to heat houses and other buildings, to fire incinerators, and to operate automobiles add to the density of the total contamination.

It is no longer feasible to banish industry to fringe areas. As an expert in air pollution said recently: "Few locations are now available for heavy industry where ideal transportation, raw material, power and other economic factors justify moving a plant into an undeveloped area where it can avoid the community. The community encroaches rapidly." [5]

Factors Affecting the Density of Contamination

Foreign particles, gases, and fumes in ordinary course are dissipated in the atmosphere naturally and effectively. But where there is a dense concentration of population and industry, the atmosphere becomes overloaded. Its inherent waste-abatement capacities, even when aided by mechanical devices, then may prove inadequate.

Normally the atmosphere is cleansed by air movement. Either the wind blows horizontally or there is an upward current produced by the tendency of warm air at the earth's surface to rise toward the cooler regions above. The velocity, turbulence, and direction of wind are thus important natural factors in removal of pollutants from the atmosphere.

Under certain meteorological conditions, a contaminated

[5] Leslie Silverman, of the Harvard School of Public Health, to International Congress on Air Pollution of the American Society of Mechanical Engineers, New York, Mar. 1-2, 1955.

air mass may be held close to the earth for a number of days. If the pollution load is heavy enough and its components are particularly noxious, human discomfort, illness, and even death may result. In the Los Angeles basin, for instance, there is a periodic temperature inversion caused by a warm air mass reaching down to the cool air that hovers close to the ocean's surface and rests in a layer over the coastal region. The warm air pressing down from above forms a sort of lid over the cool air and prevents the normal upward drift of air currents. Gentle winds, blocked by mountain ranges, move in rotary fashion, circulating but not dissipating the pollutants. The resulting low-level accumulation of irritants is usually most acute in the autumn months.

Types of Pollutants in the World's Atmosphere

Pollutants emitted into the atmosphere may be solid or liquid, gaseous or in the form of microscopic or sub-microscopic particles. They may consist of solids, crystals, vapors, dust, droplets, mist, spores, pollen grains, or bacteria. Many of these substances can combine with each other or be acted upon by sunlight or natural atmospheric gases to form new chemicals which may be even more damaging than the original wastes.

Studies of air pollution by California's state department of public health indicate the diversity of components of air pollution in areas of heavy concentration; more than 40 substances have been identified in the atmosphere along the California coast. The major offenders appear to be hydrocarbons, sulphur oxides, nitrogen oxides, aldehydes, acids, and various organic substances. Their principal sources are petroleum refineries, metal and chemical plants, motor vehicle exhausts, municipal, industrial, and domestic heating equipment and incinerators, and plants employing certain processes involving minerals, grain, and food products.

The Stanford Research Institute estimates that in the Los Angeles area in 1953 nearly 2,700 tons of various pollutants were emitted into the atmosphere solely from the burning of fuel and refuse. Approximately 1,200 tons of gasoline vapors (hydrocarbons) were released every day from motor vehicles. Although the amount of hydrocarbons going into the air from petroleum refineries had been cut by two-thirds since 1951, some 210 tons still were being emitted daily in January 1955. Additional pollutants were

cast off in significant quantities by chemical, paint, roofing, rubber and soap factories. The area's atmosphere also contained substances from remote sources, such as dust and particles from forest fires, pollens, and radioactive materials from atomic bomb tests and other operations producing radioactivity.[6]

Air pollution is considered primarily an urban problem but it can originate also in rural areas, and agricultural production may be seriously affected by atmospheric contamination from urban or rural sources. The California health department has found that few rural areas in the state, with the exception of the higher mountain slopes, are free from air pollution. Dust storms and suspension of irrigation at certain seasons have proved serious.

Smoke and charred sawdust from burners used in sawmills often fill the valleys to the point where lowered visibility stalls motor traffic. Other forms of pollutants in rural areas include the dust emitted from cement plants, hydrogen sulphide and other noxious gases and vapors from the liquid wastes of food industries, toxic aerosols used in crop spraying, petroleum vapors given off when road building materials are treated with hot asphalt, and smoke from the smudge pots used to heat orange groves.

Economic Losses and Costs of Corrective Devices

The cost of air pollution may be computed in terms of the property damage caused by the contamination or in terms of the expenses entailed in purchasing and maintaining the facilities necessary to abate the pollution. Research activities and enforcement of air pollution control ordinances impose additional costs.

Lewis A. Chambers, director of the federal Sanitary Engineering Center at Cincinnati, asserted last year that the "economic and nuisance aspects of air pollution are becoming increasingly serious throughout the country." Major losses that he noted were those from "corrosion of structural metals, discoloration of paint, deterioration of tires and other rubber goods, soiling of buildings and wearing apparel, reduced flight and ground visibility, damage to foliage and crops, and devaluation of real property." [7]

[6] California State Department of Public Health, *Clean Air for California* (Initial Report of the Air Pollution Study Project), March 1955, pp. 14-16.

[7] Statement submitted to Senate Banking and Currency Committee, Apr. 15, 1954.

A Stanford Research Institute survey of various cost estimates has placed the total loss to the nation from air pollution at $1.5 billion, or $10 per person, annually. Per capita losses in Chicago run at twice that figure; the annual damage in Pittsburgh is estimated at $10 million; in Cincinnati at $8 million; in Cleveland at $6 million. The losses in the main represent costs of cleaning, painting, and replacing damaged merchandise and other property.[8]

Installation of abatement facilities is a costly undertaking. According to a report presented to a Staten Island, N. Y., symposium on air pollution in March 1954, the cost of controlling emissions of a 50-ton capacity open hearth furnace is approximately $600,000. Precipitator installations at large power plants cost as much as $1 million per boiler unit. A rubber plant on the West Coast spent more than $100,000 on the development phase of its air pollution control program; it then found that the plant's water supply and sewage equipment would have to be enlarged before other facilities could be installed.

Estimates of annual expenditures by industry for abatement facilities range from $100 million to $300 million; one business source has placed total spending for this purpose over the past five years at $1 billion. Results of a survey of 175 industrial establishments, reported to the American Society of Mechanical Engineers' International Congress on Air Pollution in March 1955, disclosed five-year outlays by individual companies ranging from $1,700 up to the multiple millions. The Consolidated Edison Company of New York reported the largest expenditure—$31 million since the beginning of 1950—and said it planned to spend another $15 million in the next five years. Although oil refineries in the Los Angeles area say they have spent $20 million on control devices, smog is a continuing plague there. The California Air Pollution Foundation estimates it will cost $100 million to eliminate it.

Pollution control activities of local authorities impose an unwelcome burden on city budgets, but the public in many municipalities is pressing for larger expenditures for that purpose. New York City's outlay for smog control this year is around $400,000; Chicago is spending $300,000; Cincinnati, $108,000; St. Louis, $100,000.

[8] Twenty department stores in 15 large cities checked by the Stanford Research Institute reported annual losses ranging from $20,000 to $50,000 each; hotels reported outlays of $9,000 to $25,000 each; hospitals, $4,000 to $20,000; office buildings, $11,000 to $35,000.

SMOG'S ILL EFFECTS ON HEALTH OF HUMAN BEINGS

Theoretically, human health would be served best if only pure air were breathed, but that is an ideal impossible of attainment. Contaminants are injected into the atmosphere even by such natural phenomena as dust storms, forest fires ignited by lightning, and volcanic eruptions. A certain amount of man-made pollution also has to be accepted as the price of modern social and industrial organization. But as the level of contamination increases, a serious question arises as to how much human organisms can tolerate without hazard to health.

Several episodes in recent years demonstrate that, under certain conditions, smog can kill. During one week, in late October 1948, one-half of the 7,000 inhabitants of Donora, Pa., suffered acute illness and 21 died; the symptoms were cough, sore throat, chest constriction, shortness of breath, eye irritation, nausea. A heavy London fog in 1952, which held contaminants close to ground level for three days, apparently was responsible for an excess of 3,000 deaths over the normal mortality for the period; sufferers complained chiefly of irritation of the respiratory tract.

Incursions of smog in California coastal areas have caused irritation of the eyes, nose, and respiratory tract. The Los Angeles school superintendent reported that during a particularly severe siege that lasted 18 days in October 1954, all schools in the worst affected areas reported substantial increases in headaches, cough, eyestrain, and nasal discharge. Although an official check-up of mortality statistics, from August through November last year, indicated no excess of deaths during smog periods, the state department of health reported that the Los Angeles area was "not immune to the type of disaster which struck Donora or London." It concluded that "At the present time . . . we do not know how and when such a disaster could occur, because the determining factors responsible for such fatal episodes are not understood."

A review of the London tragedy by the British Ministry of Health found that "The fog was a precipitating agent operating on a susceptible group of patients whose life expectation . . . must even in the absence of fog have been short." Industry groups tend to discount fears that air contamination, at least at present levels, presents a serious health menace. The Air Pollution Abatement Manual of the

Manufacturing Chemists Association states that "Most of the actual [physiological] difficulties have been of a limited extent and of relatively minor significance"; it asserts that wherever acute toxic effects have occurred, they have been induced by accidental circumstances—either the unintentional release of large amounts of noxious matter or an "accident of weather." It is sometimes suggested also that psychological factors may be at the root of mass outbreaks of smog complaints.

Smog illness is an acute reaction to an abnormally heavy and persistent concentration of air pollution over a relatively short period of time. Medical authorities are now giving attention to the possibility that less perceptible ailments may be caused by continuing or frequent exposure to relatively small amounts of pollution over a long period of time. Certain materials which have produced cancer in laboratory animals—including benzpyrene, which is present in automobile exhausts—have been identified in air samples. Dr. Raymond F. Kaiser of the National Cancer Institute said in a copyrighted interview in the Mar. 25 issue of *U. S. News & World Report* that there are several hundred chemicals and other materials, encountered every day, which can bring on cancer in animals. If exposure to these substances in the air is related to human cancer, Kaiser felt "there must be a long latent period involved" and "the frequency and extent of exposure" might be contributing factors.

Problems in Control of Air Pollution

REGULATION of air pollution has been traditionally a function of local governments, exercised under general police powers. Virtually all sizable cities have ordinances which at least limit the amount of coal smoke that may be discharged within municipal limits. Many such ordinances have been amended in recent years to make them apply to other forms of air pollution.

Enforcement has been hampered, however, by lack of sufficient funds and technical personnel to deal with some of the newer types of pollution. A recent official survey in New York, for example, showed that 455 communities had

a recognizable air pollution problem, but that only eight of the communities had full-time personnel to handle it. Municipal budgets, except in the largest cities, do not allow for maintenance of the laboratory facilities necessary for sampling and analyzing the air.

Technical aid of some kind is available to localities in 41 states, but only six states have made specific provision for such activity. Usually the department of health performs this function as part of an overall environmental health program. Oregon in 1951 and New Jersey in 1954 established separate air pollution control units in their health departments, and Massachusetts last year enacted legislation placing specific responsibility for air pollution activities in the state division of sanitary engineering. In these three states, the authorized units have power to promulgate control regulations. The Oregon Air Pollution Authority also is responsible for developing a state-wide control program and investigating specific problems brought to its attention by complaints.

Maryland and Pennsylvania maintain air pollution sections, within the state industrial hygiene bureaus, that have authority to investigate local situations and aid local authorities on air pollution problems. The Pennsylvania agency has two mobile laboratory units for field studies. The State of Washington last year made funds available for a state-wide air pollution advisory service, while an experimental research laboratory at the state university carries on air pollution studies on a fee basis for public and private agencies. Other states are considering new legislation or have established legislative committees or other commissions to study the need for additional statutory action.

Because local areas of pollution tend to overstep city boundaries, there is a trend toward enlarging the jurisdiction of enforcement agencies. California in 1947 authorized its counties to declare themselves "air pollution control districts" in order to carry on a more effective fight against smog, and Kentucky in 1952 enacted similar legislation. County-wide authorities operate also in some parts of Pennsylvania. New York last year authorized expenditure of $40,000 by the Interstate Sanitation Commission to combat smog in the New York metropolitan area, on condition that New Jersey put up an equal amount; however, New Jersey ignored the offer, as it did a similar proposal in 1952.

HAZARDS IN POPULAR DEMAND FOR "CRASH PROGRAMS"

Public demand that "something be done" about air pollution "right away" has aroused apprehension in industrial circles, lest it lead to adoption of stringent regulations that will require companies to make excessive and possibly fruitless expenditures. An official of E. I. du Pont de Nemours & Co. sees in the recent multiplication of air pollution ordinances a "danger that the laws will be too broad in scope and inflexible in standards, giving rise to difficulties both in compliance and enforcement." A management spokesman commented before the recent air pollution congress of the American Society of Mechanical Engineers that "Regulations as to the amount of smoke, fumes, pollutants and the like are adopted often without any idea of their effect either on the nuisance under attack or on the economics of the community."

An official of the Aluminum Company of America, writing in the Manufacturing Chemists Association manual, deplored "superficial consideration of the air pollution problem [which] leads to the fallacious view that the remedy is to establish concentration limits for each air contaminant at the source of emission and apply them uniformly to all areas." Such a procedure was called "fundamentally wrong, both technically and economically, because it requires everyone to meet the restrictions required for the worst situation." Yet "this approach forms the basis for much of the existing legislation." The Los Angeles control program was criticized on the ground that it was "created and set in motion before the facts were ascertained," with the result that "in less than two years, 12 million dollars were spent . . . for the reduction and control of air pollution—all without knowing what to correct."

Testifying before the House Appropriations subcommittee in February, Assistant Surgeon General Hollis noted: "Community air pollution is becoming such an issue that it may tend to force local 'crash programs' and other expensive actions far ahead of basic technical knowledge"; some of these hasty corrective actions "may prove to be not very effective."

Business spokesmen frequently make the point that the public fails to recognize the impact on the economy, and particularly on consumer prices, of heavy expenditures for air cleansing equipment. Furthermore, if local authorities impose requirements beyond the financial capacity of a busi-

ness to meet, and its plants shut down, the result may be far more damaging to the life of a community than a certain amount of physically tolerable air pollution. A program of public relations by industry, which would explain the need to develop and apply economically feasible solutions to a local pollution problem, is frequently advocated.

Search for Simple, Inexpensive Means of Control

Industry's stake in the development of cheaper and simpler methods of air cleansing largely accounts for the intensification of technical research in this field and the growing number of technical conferences on the subject. Leslie Silverman, of the Harvard School of Public Health, told the air pollution congress of the American Society of Mechanical Engineers a month ago that "The hope in any economic evaluation of an air pollution problem is to obtain a solution which can be made without excessive cost and under conditions which do not suspend or interfere with operations for any protracted period."[9] He outlined a number of particularly pressing needs in practical research, such as development of a new method for recognizing chemical effluents not removed by contact washing and development of fabrics that could be used effectively as filters at very high temperatures.

Silverman noted that "a fair amount of inertia in the air and gas cleaning industry" had resulted in failure to apply new knowledge, revealed by basic research, to improvement of standard pollution abatement equipment. "Many control equipment manufacturers," he said, "are producing equipment which is applied to processes before a thorough investigation is made as to the nature of the contaminant."

Development of methods for recovering by-products that are salable or that can be re-used bears importantly on the economics of air pollution control. In the steel industry recovery of material from blast furnaces has made up in part the costs of pollution abatement. It was reported to the air pollution congress that installation of new equipment at petroleum refineries would result, by the end of 1955, in the recovery from sour gases of approximately 1,000 tons of sulphur daily. The new equipment also will

[9] Prevention of a recurrence of the killing smog of 1948 in Donora, Pa., has been achieved by developing a means of predicting temperature inversions at an early stage and curtailing industrial operations during the danger periods.

reduce, by around 2,000 tons a day, the volume of sulphur dioxide going into the atmosphere.

Basic research on the effects of air contamination on human and animal health and on vegetation also is important to the economics of air pollution control. Such studies, which are being undertaken chiefly by government agencies and in the universities, will provide the information needed to establish standards of tolerance that will protect industry from unrealistic regulations. Until there is a solid core of scientific knowledge on the causes and effects of air contamination at various levels, in various combinations of pollutants, and under different circumstances of weather and topography, the demand for shotgun control measures probably will persist.

Dangers of Radioactivity and Fall-Out

RADIOACTIVE CONTAMINATION of the atmosphere presents to the average person a far more fearsome prospect than any other form of air pollution. It bears a death threat for individuals and also the possibility of doing irreparable physical damage to the human race as a whole. Despite assurances from public officials that the risks from radioactivity released by the testing of nuclear weapons are minimal, public uneasiness lingers because of the concern voiced by a number of American and British scientists.

The giant fireball created by a nuclear explosion carries aloft particles of matter impregnated with deadly radioactivity. The matter may consist of fragments of bomb casings, soil or subsoil pulverized by the explosion, sodium or other materials brought up from the sea, or dust already present in the atmosphere. The heavier particles descend to the surface rapidly in the blast area, but finer substances are held in an elliptical cloud which moves downwind and from which there is a delayed fall-out of the radioactive matter. The area over which the cloud passes faces the greatest threat of radioactive poisoning in the first and second days following the detonation. When a hydrogen bomb was tested near the Pacific atoll of Bikini on Mar. 1, 1954, fall-out of radioactive coral dust began eight hours later at a point approximately 160 miles away from the site of the test.

Still finer radioactive particles may be carried to high altitudes and travel great distances, possibly around the world. This is particularly likely to happen after a high burst. The radioactivity in some of the drifting particles is dissipated quickly; in others the radioactivity may persist for weeks or months, though its potency steadily declines. According to the Atomic Energy Commission, "As the particles are carried farther and farther to remote areas, the possibility of significant amounts of fall-out decreases."[10] Considerable apprehension nevertheless has been felt over the possibility that the world-circling drift of radioactive matter, particularly if replenished by additional nuclear explosions, may constitute a permanent danger and have unknown effects on the genetics of the human race.

The Atomic Energy Commission announced on Feb. 15 that a hydrogen bomb like the one exploded at Bikini in 1954 could blanket an area the size of New Jersey—7,000 square miles—with deadly radioactive fall-out. Such a hazard would arise only if the bomb were detonated by an enemy in war. When nuclear weapons are tested in peacetime, precautions are taken to keep people away from the area of maximum contamination.[11]

Controversy Over Risks in Testing Nuclear Weapons

Although the hazards of atmospheric pollution from use of nuclear weapons in warfare are not debatable, the question of whether a substantial threat is posed by the radioactivity produced by peacetime testing of those devices is highly controversial. The Federation of American Scientists suggested on Mar. 6 that the United Nations sponsor a study to determine how many nuclear bomb tests the human race can stand. The Federation said: "It should be clear that future accelerated H-bomb test programs, by several atomic powers, will ultimately reach a level which can be shown to be a serious threat to the genetic safety of all the people."

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[10] Three days after an atomic test explosion in Nevada on Mar. 7, the Weather Bureau reported that a radioactive cloud stretched two miles above ground level from Nebraska to northern Virginia. But there was "little, if any, radioactive fall-out." A.E.C. Chairman Strauss said on TV, Apr. 3, that it would take 10,000 of the small Nevada tests to produce as much radiation as that created by the larger Pacific tests.

[11] There was apparently a lapse in the precautions at Bikini. A.E.C. Chairman Strauss said on Mar. 31, 1954, that the Japanese fishing boat, whose crew members were burned by fall-out from the explosion there, was overlooked when the area marked for clearance was searched before the blast. The boat was "well within" the test zone.

Linus Pauling, Nobel prize winner in chemistry, observed on Mar. 21 that gamma radiation from nuclear tests was potentially hazardous to cancer-susceptible individuals; he recommended halting all tests because of the "world-wide effects" of radioactive fall-out. Frederick Soddy, one of Britain's first atomic scientists, had asserted that experimental explosions were "fouling the air with radioactivity" and that it was "nonsense to say it is harmless." He contended that mutations of human genes might be caused to the extent of jeopardizing mankind's fertility. Another British atomic physicist, Joseph Rotbiat, recently commented that there might be no danger in doubling the natural radiation in the atmosphere, but he added that it would be "rather risky to assume that any higher activity is safe"; a "disastrous result for the entire human species" might not become apparent for 100 years.

Six women members of the British House of Commons recently called for a halt to all nuclear tests—described by one of them as "a threat to woman's procreative powers"—until an international conference of scientists could determine the cumulative effect of radiation on unborn generations. But the House on Mar. 22 refused, by a vote of 290 to 250, to support the plea.

The Atomic Energy Commission said on Feb. 15 that the total amount of radiation received by a resident of the United States from all nuclear explosions in the world up to that date had been around one-tenth of one roentgen—"about the same as the exposure received from one chest X-ray." The commission reported that its medical and biological advisers "believe that the small amount of additional exposure . . . will not seriously affect the genetic constitution of human beings." Conceding that "at our present stage of genetic knowledge, there is a rather wide range of admissible opinion on this subject," the A.E.C. said it was "continuing our thorough study of this entire question" and would keep the public informed of its findings.[12]

Possible hazards from excessive radiation in the atmos-

[12] Robert H. Holmes, director of the U. S. Atomic Bomb Casualty Commission in Japan, reported on a TV program on Mar. 29 that a decade-long study of the victims of the Hiroshima bombing disclosed that infertility among those exposed to heavy radiation proved temporary. Slightly smaller than normal heads and some degree of mental retardation were found among 8 per cent of the babies born to women pregnant at the time of the explosion. Later offspring "appear to be normal, healthy, and happy," though "what the future will show is a problem for further investigation." The chief observable physical damage to those exposed to heavy radiation was a sharp increase in susceptibility to leukemia (blood cancer) and to minor eye cataracts.

phere are not limited to the effects of nuclear warfare or weapons testing. They include also the factor of radioactive discharge from utilization of nuclear energy for peaceful purposes. Assistant Surgeon General Hollis told the House Appropriations subcommittee on Feb. 11 that "Nuclear reactors for power production and increased utilization of radioisotopes are considerably broadening the distribution and prevalence of radioactive materials." The air sampling program at the Taft Center is expected to provide needed information on the radiation levels of major metropolitan areas. The Public Health Service, in cooperation with the Atomic Energy Commission, is engaged in research also on the behavior of radioactive waste materials in the air, water, and soil and on means of safely and effectively disposing of such materials.